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Statistics on Aircraft Gas Turbine Engine Rotor Failures that Occurred in U.S. Commercial Aviation During 1987

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Final Report

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16. Abstract

This report presents statistical information relating to gas turbine engine rotor failures which occurred during 1987 in U.S. commercial aviation service use. Three hundred thirty-two failures occurred in 1987. Rotor fragments were generated in 170 of the failures, and of these 12 were uncontained. The predominant failure involved blade fragments, 95 percent of which were contained. Four disk failures occurred and all were uncontained. Forty-nine percent of the 332 failures occurred during the takeoff and climb stages of flight.

This service data analysis is prepared on a calendar year basis and published yearly. The data are useful in support of flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses.

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EXECUTIVE SUMMARY

This service data analysis is prepared on a calendar-year basis and published annually. The data support flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses. The following statistics are based on gas turbine engine rotor failures that have occurred in United States commercial aviation during 1987.

Three hundred and thirty-two rotor failures occurred in 1987. These failures accounted for approximately 17.7 percent of the 1872 shutdowns experienced by the United States commercial fleet. Rotor fragments were generated in 170 of the failures and, of these, 12 were uncontained. This represents an uncontained failure rate of 1.0 per million gas turbine engine powered aircraft flight hours, or 0.3 per million engine operating hours. Approximately 12.5 million and 39.5 million aircraft flight and engine operating hours, respectively, were logged in 1987.

Turbine rotor fragment-producing failures were approximately 1.8 times greater than that of the compressor rotor fragment-producing failures; 104 and 57 respectively, of the total. Fan rotor failures accounted for 9 of the fragment-producing failures experienced.

Blade fragments were generated in 164 of the rotor failures; 8 of these were uncontained. The remaining 4 uncontained failures were produced by disk fragments.

Of the 223 known causes of failures (because of the high percentage of unknown causes of rotor failures, the percentages were based on the total number of known causes), the causal factors were (1) foreign object damage --92 (41.3 percent); (2) secondary causes -- 72 (32.3 percent); and (3) design and life prediction problems -- 50 (22.4 percent). One hundred and sixty-four (49.4 percent) of the 332 rotor failures occurred during the takeoff and climb stages of flight. Ninety-four (55.3 percent) of the 170 rotor fragment-producing failures and 7 (58.3 percent) of the 12 uncontained rotor failures occurred during these same stages of flight.

The incidence of engine rotor failures producing fragments has increased when compared to 1986 (140 in 1986 and 170 in 1987). The number of uncontained engine rotor failures reported has decreased 25 percent in 1987 (16 in 1986 and 12 in 1987). The 12-year (1976 through 1987) average of uncontained engine rotor failures is 15.0.

INTRODUCTION

This report is sponsored and co-authored by the Federal Aviation Administration (FAA) Technical Center, located at the Atlantic City International Airport, New Jersey.

This service data analysis is published yearly. The data support flight safety analyses, proposed regulatory actions, certification standards, and cost benefit analyses.

The intent and purpose of this report is to present data as objectively as possible on gas turbine rotor failure occurrences in U.S. commercial aviation. Presented in this report are statistics on gas turbine engine utilization and failures that have occurred in U.S. commercial aviation during 1987. These statistics are based on service data compiled by the FAA Flight Standards District Office. The National Safety Data Branch of the FAA Aviation Standards National Field Office disseminated this information in a service difficulty data base and the Air Carrier Aircraft Utilization and Propulsion Reliability Reports. The FAA service data base contains only a fraction of the actual commercial helicopter fleet operating statistics. The number of turboshaft engines in use with the corresponding engine flight hours given herein are estimates derived primarily from statistics published by the Helicopter Association International in their helicopter annuals. The compiled data were analyzed to establish:

1. The incidence of rotor failures and the incidence of contained and uncontained rotor fragments (an uncontained rotor failure is defined as a rotor failure that produces fragments which penetrate and escape the confines of the engine casing).

2. The distribution of rotor failures with respect to engine rotor components, i.e., fan, compressor or turbine rotors and their rotating attachments or appendages such as spacers and seals.

3. The number of rotor failures according to engine model and engine fleet hours.

4. The type of rotor fragment (disk, rim, or blade) typically generated at failure.

5. The cause of failure.

6. The flight conditions at the time of failure.

7. Engine failure rate according to engine fleet hours.

RESULTS

The data used for analysis are contained in appendix A. The results of these analyses are shown in figures 1 through 7 and tables 1 and 2.

Figure 1 shows that 332 rotor failures occurred in 1987. These rotor failures accounted for approximately 17.7 percent of the 1872 shutdowns experienced by the gas turbine powered U.S. commercial aircraft fleet during 1987. Rotor fragments were generated in 170 of the failures experienced and, of these, 12 (7.1 percent of the fragment-producing failures) were uncontained. This represents an uncontained failure rate of 1.0 per million gas turbine engine powered aircraft flight hours, or 0.3 per million engine operating hours.

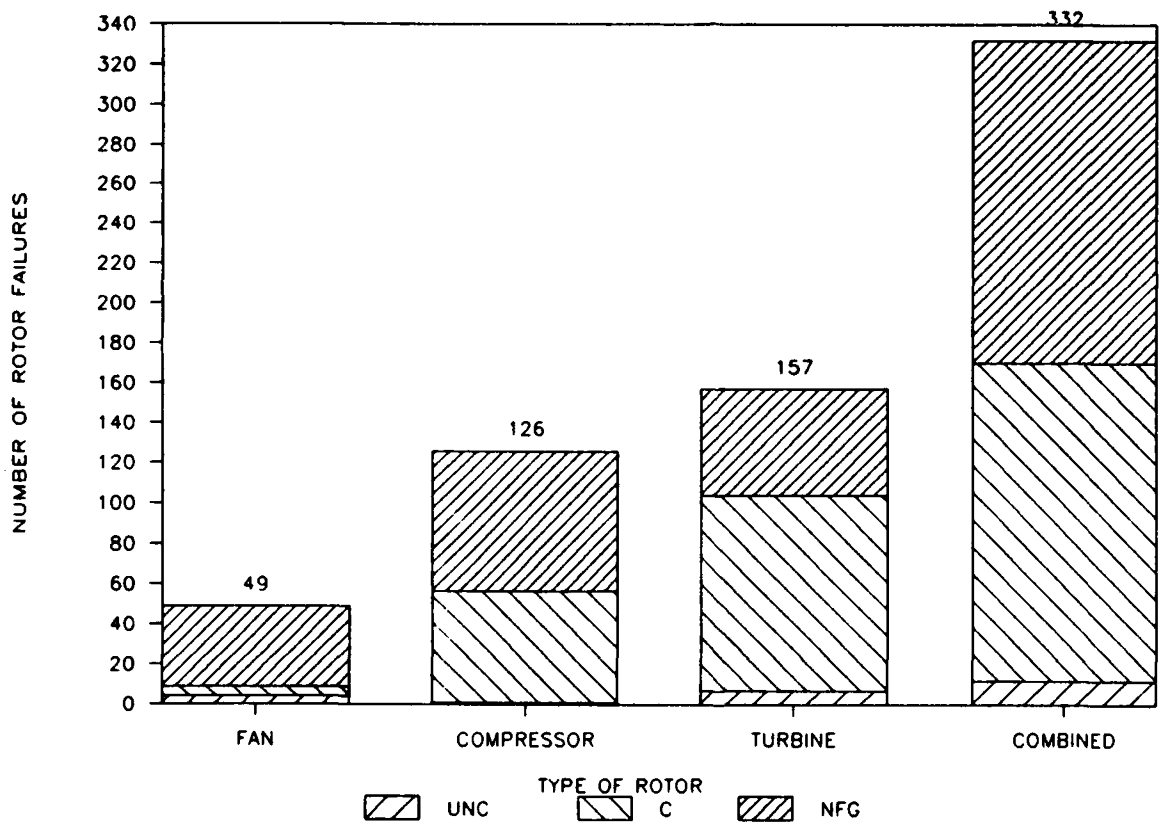

FIGURE 1. INCIDENCE OF ENGINE ROTOR FAILURES IN U.S COMMERCIAL AVIATION - 1987

Approximately 12.5 million and 39.5 million aircraft flight and engine operating hours, respectively, were logged by the U.S. commercial aviation fleet in 1987. Gas turbine engine fleet operating hours relative to the number of rotor failures and type of engines in use are shown in figure 2.

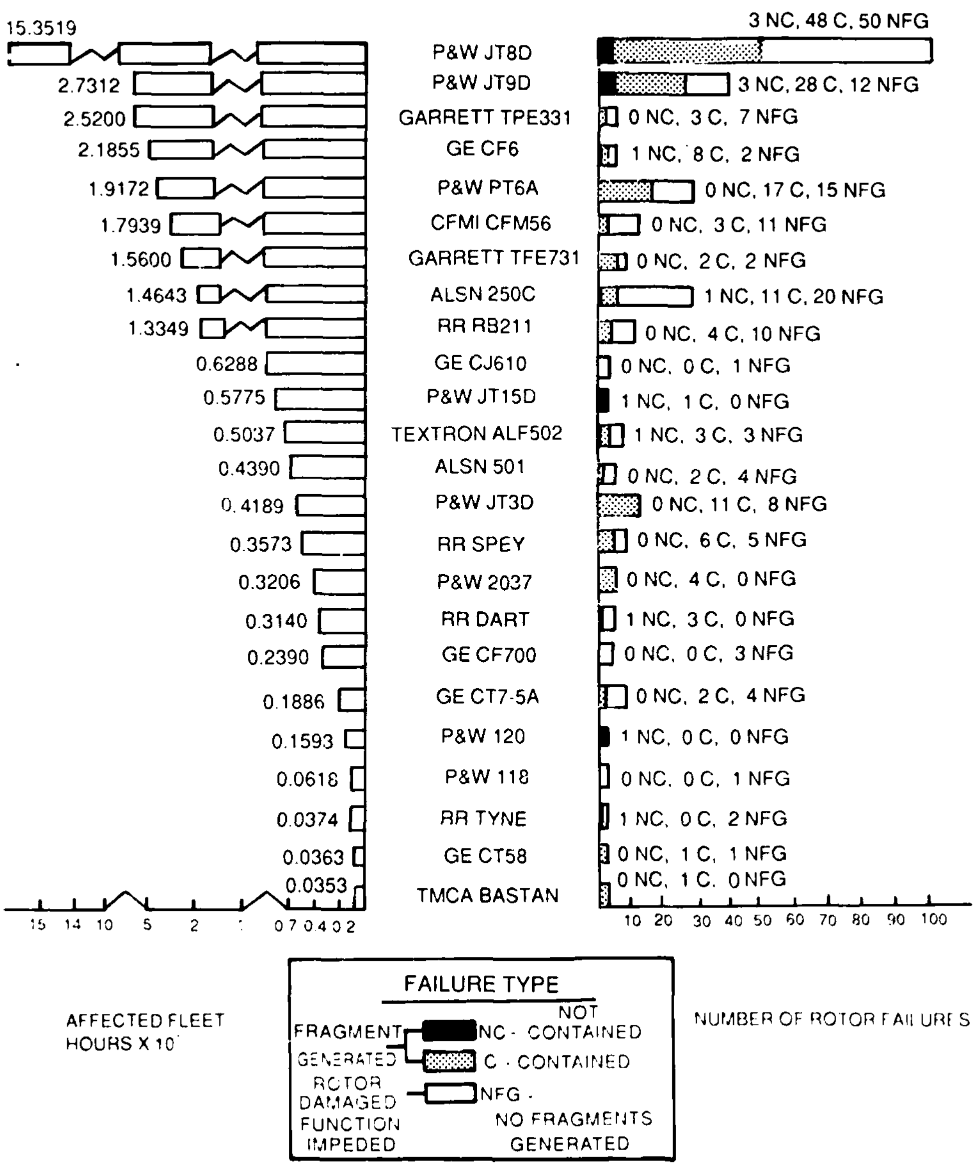

FIGURE 2. TYPE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION ACCORDING TO AFFECTED ENGINE MODEL AND ENGINE FLEET HOURS 1987

Figure 3 shows the distribution of rotor failures that produced fragments according to the engine component involved (fan, compressor, turbine), the type of fragments that were generated, and the percentage of uncontained failures according to the type of fragment generated. These data indicate that:

1. The incidence of turbine rotor failures was approximately 1.8 times greater than that of the compressor rotor failures; these corresponded to 104 (61.2 percent) and 57 (33.5 percent), respectively, of the total number of failures. Fan rotor failures accounted for 9 (5.3 percent) of the failures experienced.

2. Blade fragments were generated in 164 (96.5 percent) of the failures; eight (5.0 percent) of these were uncontained. The remaining six (3.5 percent) failures were produced by disk, rim, and seal. All four of the disk failures were uncontained. There were no uncontained rim or seal failures.

ENGINE ROTOR COMPONENTS	TYPE OF FRAGMENT GENERATED									
	DISK		RIM		BLADE		SEAL		TOTAL	
	TF	UCF	TF	UCF	TF	UCF	TF	UCF	TF	UCF
FAN	2	2	0	0	7	2	0	0	9	4
COMPRESSOR	0	0	1	0	55	1	1	0	57	1
TURBINE	2	2	0	0	102	5	0	0	104	7
TOTAL	4	4	1	0	164	8	1	0	170	12

TF - TOTAL FAILURES
UCF - UNCONTAINED FAILURES

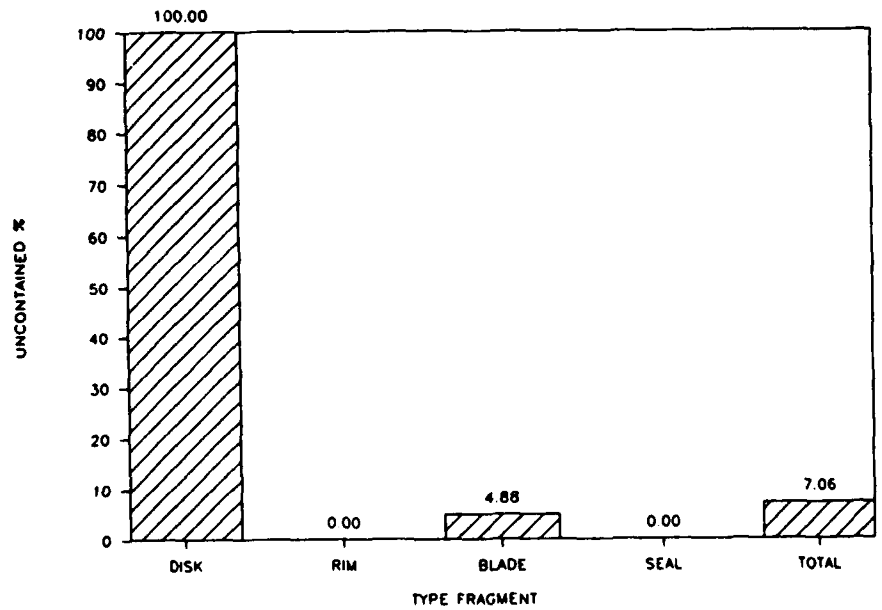

FIGURE 3. COMPONENT AND FRAGMENT TYPE DISTRIBUTIONS FOR CONTAINED AND UNCONTAINED ENGINE ROTOR FAILURES (FAILURES THAT PRODUCED FRAGMENTS) - 1987

Figure 4 shows the rotor failure distribution among the engine models that were affected and the total number of models in use.

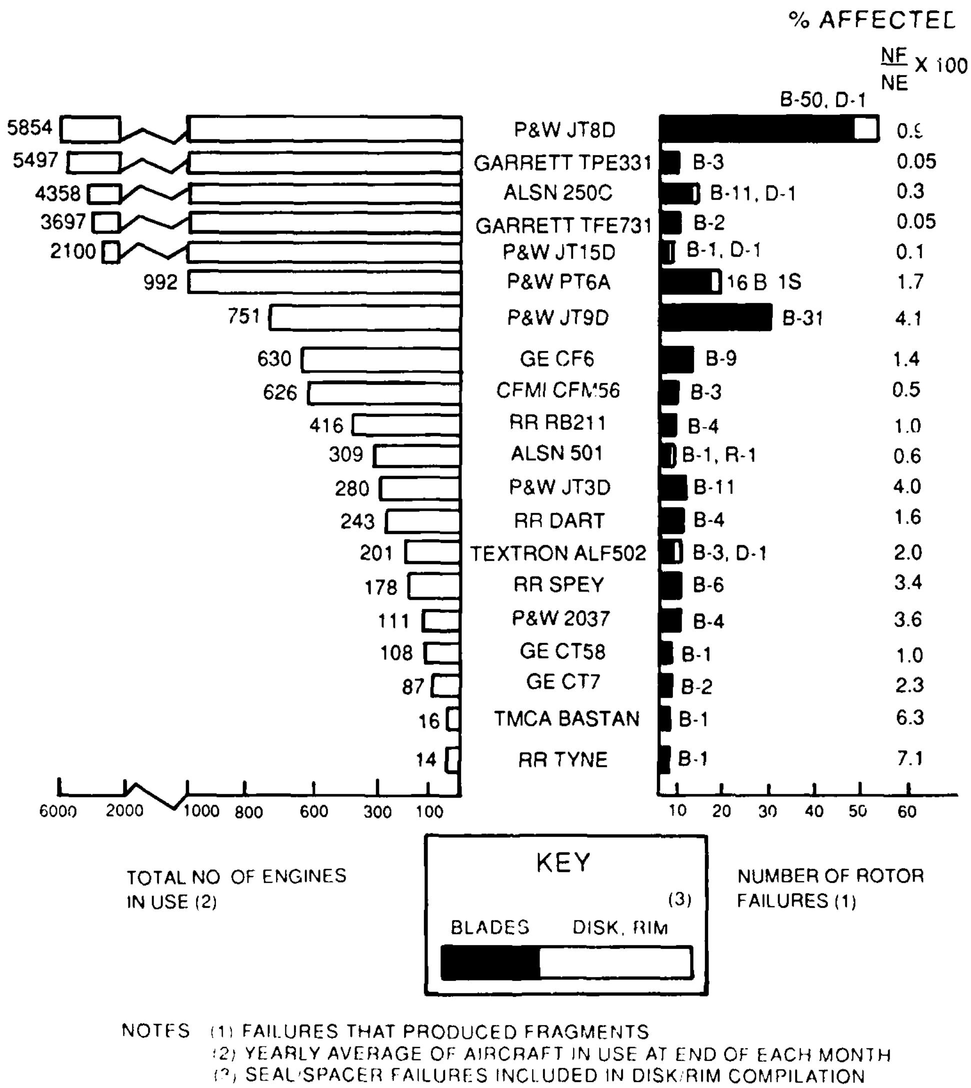

FIGURE 4. THE INCIDENCE OF ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION ACCORDING TO ENGINE MODEL AND COMPONENT AFFECTED - 1987

Figure 5 shows what caused the rotor failures to occur. Of the 223 known causes of failure (because of the high percentage of unknown causes of rotor failure, the percentages were based on the total number of known causes), the causal factors were (1) foreign object damage -- 92 (41.39 percent); (2) secondary causes -- 72 (32.3 percent); and (3) design and life prediction problems -- 50 (22.4 percent).

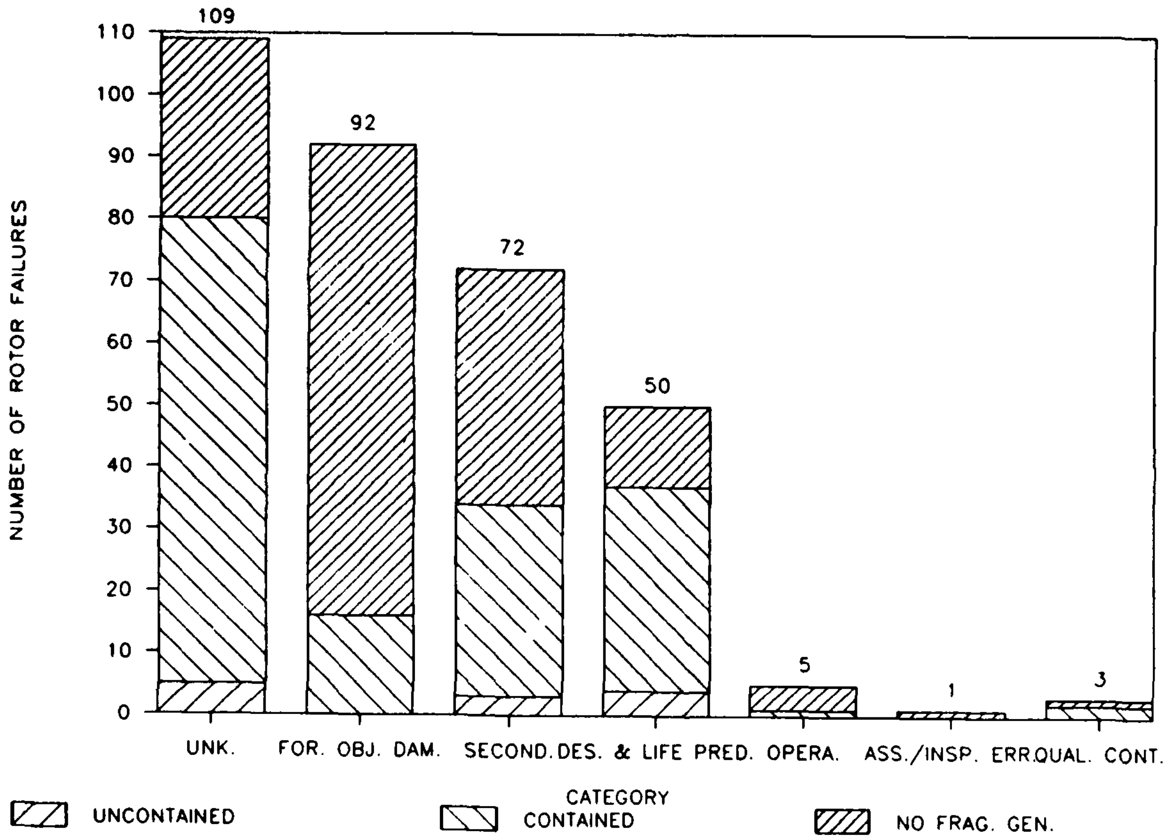

FIGURE 5. ENGINE ROTOR FAILURE CAUSE CATEGORIES - 1987

Figure 6 indicates the flight conditions that existed when the various rotor failures occurred. One hundred and sixty-four (49.4 percent) of the 332 rotor failures occurred during the takeoff and climb stages of flight. Ninety-four (55.3 percent) of the rotor fragment-producing failures and 7 (58.3 percent) of the uncontained rotor failures occurred during these same stages of flight. The highest number of uncontained rotor failures, 5 (42.0 percent), happened during takeoff.

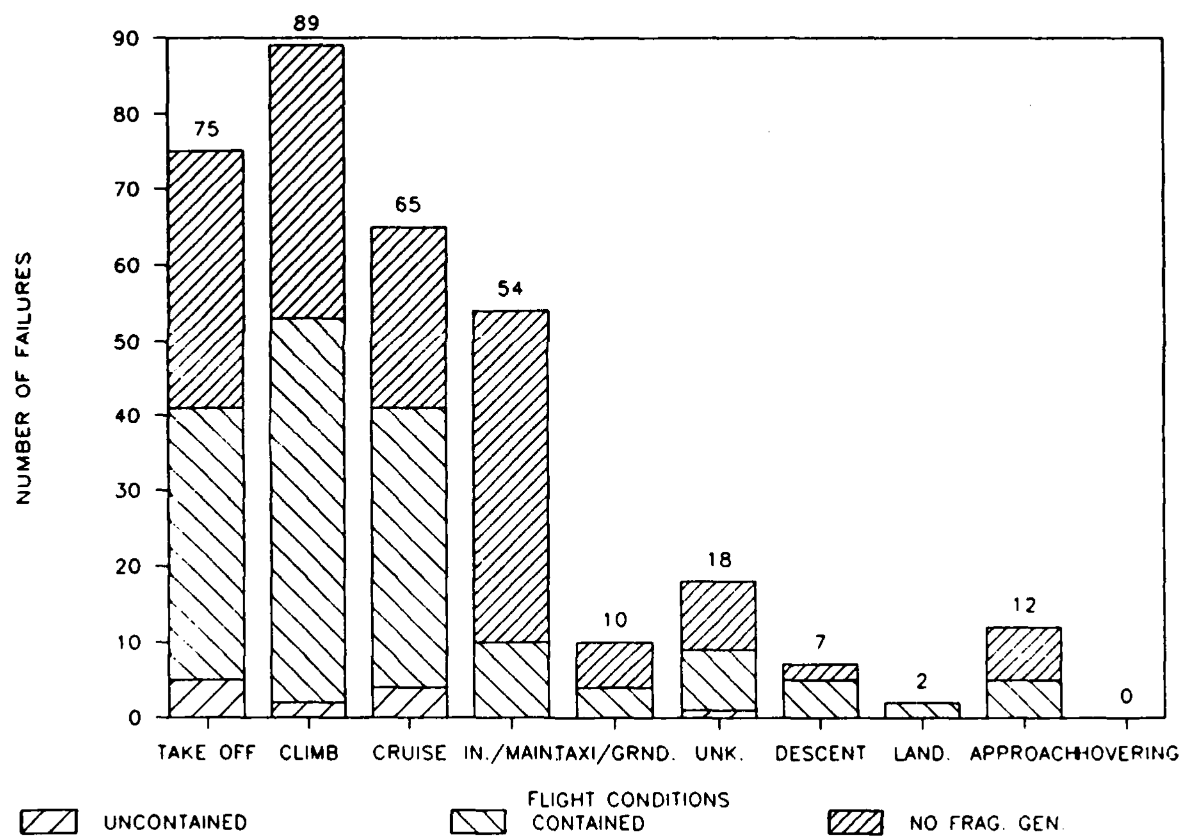

FIGURE 6. FLIGHT CONDITION AT ENGINE ROTOR FAILURE - 1987

Table 1 contains a compilation of engine failure rates per million engine flight hours according to engine model, engine type, and containment conditions. The engine failure rates per million flight hours by engine type are turbofan -- 8.4, turboprop -- 11.3, and turboshaft -- 16.9. Uncontained engine failure rates per million flight hours by engine type were turbofan -- 0.3, turboprop -- 0.5, and turboshaft -- 0.5.

Table 2 is a cumulative tabulation that describes the distribution of uncontained rotor failures according to fragment type, engine component involved, cause category, and flight condition (takeoff and climb are defined as "high power," all other conditions are defined as "low power") for the years 1976 through 1987. This figure is expanded yearly to include all subsequent uncontained rotor failures. These data indicate that for "secondary causes" the number of uncontained failures was approximately five times greater at high power than low power (namely 34 and 7). For "design and life prediction problems" the number of high power uncontained failures was approximately three times greater than low power (namely 30 and 9); and for "foreign object damage" the number of uncontained failures was four times greater at high power than low power (namely 8 and 2). This tabulation also indicates that of the 181 total uncontained incidences, blade failures accounted for 66.3 percent; disk failures 22.6 percent; rim failures 4.4 percent; and seal/spacer failures 6.6 percent.

TABLE 1. GAS TURBINE ENGINE FAILURE RATES ACCORDING TO ENGINE MODEL AND TYPE - 1987

TYPE/ MODEL	AVERAGE NUMBER IN USE	ENGINE FLIGHT HRS.x10	NO. OF FAILURES* C	NC	N	TOTAL	FAIL. RATES/10 ENGINE FLIGHT HRS. C	NC	N	TOTAL
TURBOFAN/ TURBOJET										
JT8D	5854	15.3519	48	3	50	101	3.1	0.2	3.3	6.6
JT3D	280	0.4189	11	0	8	19	26.3	0.0	19.1	45.4
JT9D	751	2.7312	28	3	12	43	10.3	1.1	4.4	15.7
CF6	630	2.1855	8	1	2	11	3.7	0.5	0.9	5.0
RB211	416	1.3349	4	0	10	14	3.0	0.0	7.5	10.5
PW2037/2040	111	0.3206	4	0	0	4	12.5	0.0	0.0	12.5
SPEY	178	0.3573	6	0	5	11	16.8	0.0	14.0	30.8
TFE731	3697	1.5600	2	0	2	4	1.3	0.0	1.3	2.6
CFM56	626	1.7939	3	0	11	14	1.7	0.0	6.1	7.8
ALF502	201	0.5037	3	1	3	7	5.9	2.0	5.9	13.9
JT15D	2100	0.5775	1	1	0	2	1.7	1.7	0.0	3.5
CF700	498	0.2390	0	0	3	3	0.0	0.0	12.6	12.6
CJ610	1310	0.6288	0	0	1	1	0.0	0.0	1.6	1.6
TOTAL	16,652	28.0032	118	9	107	234	4.2	0.3	3.8	8.4
TURBOPROP										
PT6A	992	1.9172	17	0	15	32	8.9	0.0	7.8	16.7
A501	309	0.4390	2	0	4	6	4.6	0.0	9.1	13.7
TPE331	5497	2.5200	3	0	7	10	1.2	0.0	2.8	4.0
DART	243	0.3140	3	1	0	4	9.6	3.2	0.0	12.7
PW120	73	0.1593	0	1	0	1	0.0	6.3	0.0	6.3
BASTAN	16	0.0353	1	0	0	1	28.3	0.0	0.0	28.3
TYNE	14	0.0374	0	1	2	3	0.0	26.7	53.5	80.2
CT7-5A	87	0.1886	2	0	4	6	10.6	0.0	21.2	31.8
PW118	26	0.0618	0	0	1	1	0.0	0.0	16.2	16.2
TOTAL	7,257	5.6726	28	3	33	64	4.9	0.5	5.8	11.3
TURBOSHAFT										
A250C	4358	1.4643	11	1	20	32	7.5	0.7	13.7	21.9
CT58	108	0.0363	1	0	1	2	27.5	0.0	27.5	55.0
ALL OTHERS	1534	0.5154	0	0	0	0	0.0	0.0	0.0	0.0
TOTAL	6,000**	2.0163**	12	1	22	34	5.9	0.5	10.9	16.9

C = CONTAINED NC = NOT CONTAINED
N = FUNCTION IMPEDED, NO FRAGMENTS GENERATED

*As reported by service difficulty reports only.
**Estimated total number in use and engine flight hours for entire U.S. commercial fleet.

TABLE 2. UNCONTINED ENGINE ROTOR FAILURE DISTRUBUTIONS ACCORDING TO CAUSE AND FLIGHT CONDITIONS - 1976 THROUGH 1987

TYPE OF FRAGMENT GENERATED		DISK			RIM			BLADE			SEAL				
ENGINE ROTOR COMPONENT		FAN	COMP	TURB	FAN	COMP	TURB	FAN	COMP	TURB	FAN	COMP	TURB	SUB TOT	TOTAL
CAUSE	FLIGHT COND.														
DESIGN/LIFE PREDICTION PROBLEMS	HI	1	5	0	0	3	0	9	9	2	0	1	0	30	
	LOW	0	1	3	0	0	0	1	0	4	0	0	0	9	39
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
SECONDARY CAUSES	HI	0	1	0	0	0	0	5	4	21	0	0	3	34	
	LOW	0	0	1	0	0	0	0	2	4	0	0	0	7	43
	UNK	0	0	0	0	0	0	1	0	1	0	0	0	2	
FOREIGN OBJECT DAMAGE	HI	1	0	1	0	0	0	6	0	0	0	0	0	8	
	LOW	0	0	0	0	0	0	2	0	0	0	0	0	2	12
	UNK	0	0	0	0	0	0	2	0	0	0	0	0	2	
QUALITY CONTROL	HI	0	1	0	0	0	1	2	0	0	0	0	0	4	
	LOW	0	0	0	0	0	0	0	0	0	0	0	0	0	4
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
OPERATIONAL	HI	0	0	0	0	0	0	0	0	0	0	0	0	0	
	LOW	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
ASSEMBLY/ INSP. REPORTS	HI	0	0	0	0	0	0	0	0	0	0	0	0	0	
	LOW	0	0	1	0	0	0	0	0	0	0	0	0	1	1
	UNK	0	0	0	0	0	0	0	0	0	0	0	0	0	
UNKNOWN	HI	1	2	12	0	3	0	6	10	14	1	2	3	54	
	LOW	1	0	8	0	1	0	0	2	9	0	1	1	23	82
	UNK	0	0	1	0	0	0	1	0	3	0	0	0	5	
SUBTOTAL	HI	3	9	13	0	6	1	28	23	37	1	3	6	130	
	LOW	1	1	13	0	1	0	3	4	17	0	1	1	42	181
	UNK	0	0	1	0	0	0	4	0	4	0	0	0	9	
TOTAL			41			8			120			12		181	

* Takeoff and climb are defined as "High Power" and all other conditions are defined as "Low Power".

Figure 7 shows the annual incidence of uncontained rotor failures in commercial aviation for the years 1962 through 1987. During 1987, the incidence of uncontained rotor failures decreased by four over the previous year, 1986. Over the past 12 years, 1976 through 1987, an average of 15.0 uncontained rotor failures per year have occurred. During the same time period, the rate of uncontained rotor failures has remained relatively constant at an average of approximately one per million operating hours.

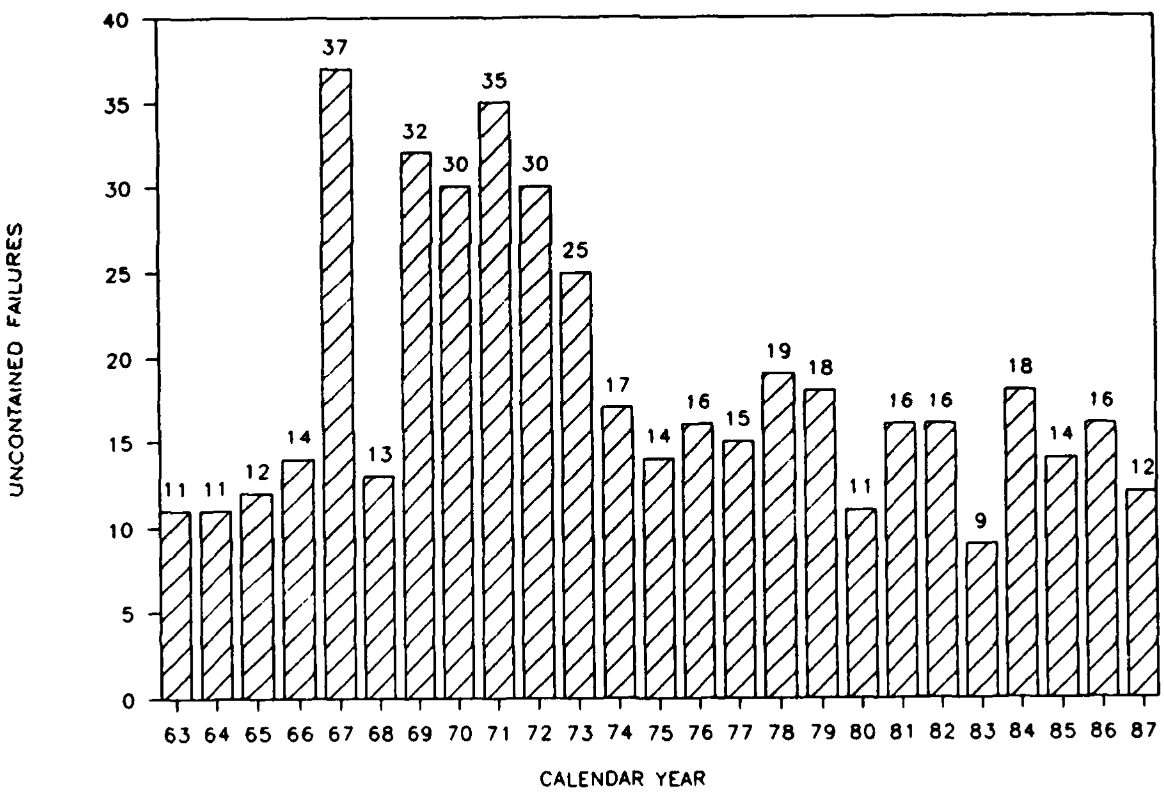

FIGURE 7. THE INCIDENCE OF UNCONTAINED ENGINE ROTOR FAILURES IN U.S. COMMERCIAL AVIATION, 1963 - 1987

DISCUSSION AND CONCLUSIONS

The incidence of engine rotor fragment-producing failures has remained relatively constant when compared to 1986 (140 in 1986 and 170 in 1987). The uncontained engine rotor failures has decreased 25 percent (12 in 1987 and 16 in 1986). The 12-year (1976 through 1987) average of uncontained engine rotor failures is 15.0.

Of the 12 uncontained events that occurred during 1987, 7 (58.3 percent) involved turbine rotors, 1 (8.3 percent) involved compressor rotors, and 4 (33.3 percent) involved fan rotors.

The predominant cause of failure was attributed to foreign object damage (41.3 percent of the known failures). No uncontained failures occurred in this category. Secondary causes (32.3 percent of the known failures) had three uncontained failures and design and life prediction problems (22.4 percent of the known causes) had four uncontained failures. Assembly and inspection error had no uncontained failures. The causes of the remaining five uncontained failures (41.7 percent) are unknown.

Uncontained failures occurred in 4 of the 10 flight modes; i.e., 5 during takeoff (41.7 percent); 2 during climb (16.7 percent); 4 in cruise (33.3 percent), and 1 was unknown (8.3 percent).

The higher incidences of uncontained rotor failures in calendar years 1967 through 1973 (except for 1968) were probably due to the introduction of newly developed engines entering the commercial aviation fleet, such as the JT9D and CF6 engines.

Structural life predictions and verification are being improved by the increased use of spin chamber testing by government and industry as a means of obtaining failure data for statistically significant samples. In addition, increased development and application of high sensitivity, nondestructive inspection methods should increase the probability of cracks being detected prior to failure. The capability to reduce the causes of failures from secondary effects is also being addressed through technology development programs. However, causes due to foreign object damage still appear to be beyond the control or scope of present technology.

APPENDIX A

Data of Engine Rotor Failures in U.S. Commercial

Aviation for 1987. Compiled from the

Federal Aviation Administration

Service Difficulty Reports.

Data Compilation Key

Component Code:
- F - Fan
- C - Compressor
- T - Turbine

Fragment Type Code:
- D - Disk
- R - Rim
- B - Blade
- S - Seal
- N - None

Cause Code:
- 1 - Design and Life Prediction Problems
- 2 - Secondary Causes
- 3 - Foreign Object Damage
- 4 - Quality Control
- 5 - Operational
- 6 - Assembly and Inspection Error
- 7 - Unknown

Containment Condition Code:
- C - Contained
- NC - Not Contained
- N - No Fragments Generated

Flight Condition Code:
- 1 - Insp/Maint
- 2 - Taxi/Grnd Hdl
- 3 - Takeoff
- 4 - Climb
- 5 - Cruise
- 6 - Descent
- 7 - Approach
- 8 - Landing
- 9 - Hovering
- 10 - Unknown

CHARACTERISTICS OF ROTOR FAILURES - 1987

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870213024	UALA	B727	JT8D	T	B	2	C	4
870727028	ATLA	B727	JT8D	T	B	2	C	4
870424019	UALA	B727	JT8D/No.3	C	B	1	NC	3
870619016	UALA	B727	JT8D	T	B	7	C	3
870403052	EALA	B727	JT8D	T	B	2	C	5
870828045	BNFA	B727	JT8D	T	B	1	C	4
870220009	TWAA	B727	JT8D	T	B	4	C	4
870327002	PEXA	B727	JT8D	C	B	7	C	5
871228041	DALA	B727	JT8D/No.2	F	B	1	NC	3
870220008	FDEA	B727	JT8D	T	B	1	C	4
870313022	NWAA	B727	JT8D	T	B	7	C	4
870417020	NWAA	B727	JT8D	C	B	1	C	3
871204042	NWAA	B727	JT8D	T	B	1	C	4
870213009	TWAA	B727	JT8D	T	B	7	C	5
870327005	TWAA	B727	JT8D	T	B	2	C	4
870213060	TAGA	B727	JT8D	T	B	7	C	5
870306018	AWXA	B737	JT8D	C	B	2	C	4
870911011	TSAA	B737	JT8D	T	B	1	C	3
870320016	SWAA	B737	JT8D	T	B	1	C	4
870807016	PAIA	B737	JT8D	C	B	1	C	6
870508013	PAIA	B737	JT8D	T	B	4	C	3
870925033	DALA	B737	JT8D	C	B	1	C	4
870213021	RJEF	B737	JT8D	T	B	2	C	5
870410014	PAIA	B737	JT8D	T	B	2	C	5
870828018	UALA	B737	JT8D	F	B	1	C	2
870615020	PAIA	B737	JT8D	T	B	7	C	5
871211063	RJEF	B737	JT8D	T	B	2	C	5
880104009	DALA	B727	JT8D	C	B	3	C	4
880104018	UALA	B727	JT8D	T	B	1	C	10
880115022	PAAA	B727	JT8D	C	B	7	C	3
880129010	NWAA	B727	JT8D	T	B	2	C	4
880108002	USAA	B727	JT8D/No.2	F	D	1	NC	3
870911007	NWAA	DC9	JT8D	T	B	2	C	3
870918002	TAGA	DC9	JT8D	C	B	3	C	3
870529015	TWAA	DC9	JT8D	T	B	2	C	4
871106008	HALA	DC9	JT8D	T	B	7	C	3
870417012	REPA	DC9	JT8D	C	B	3	C	4
871016011	REPA	DC9	JT8D	T	B	1	C	4
870911004	NWAA	DC9	JT8D	T	B	1	C	4
870417018	EALA	DC9	JT8D	T	B	7	C	3
870306023	USAA	DC9	JT8D	T	B	7	C	3
870925035	REPA	DC9	JT8D	T	B	2	C	5
870518085	OZAA	DC9	JT8D	F	B	3	C	3
870824061	REPA	DC9	JT8D	T	B	7	C	3
870515004	NWAA	DC9	JT8D	T	B	1	C	3
870706011	REPA	DC9	JT8D	T	B	7	C	3
870501008	MACA	DC9	JT8D	C	B	2	C	4
870925193	PSAA	DC9	JT8D	C	B	3	C	4
870417015	USAA	B727	JT8D	T	B	1	C	4
870911008	NWAA	B727	JT8D	T	B	1	C	4

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870410015	PAIA	B727	JT8D	C	B	3	C	4
870403036	MIDA	DC9	JT8D	T	N	7	N	4
870921100	MIDA	DC9	JT8D	T	N	7	N	3
870130079	MIDA	DC9	JT8D	T	N	7	N	3
871019050	HALA	DC9	JT8D	C	N	3	N	4
871009133	HALA	DC9	JT8D	C	N	3	N	1
870413044	CALA	DC9	JT8D	F	N	3	N	4
871023015	AALA	DC9	JT8D	T	N	7	N	7
870828031	NWAA	B727	JT8D	T	N	7	N	4
870807040	PCSA	B727	JT8D	T	N	2	N	1
870821020	PAIA	B727	JT8D	C	N	3	N	6
870529048	PAIA	B727	JT8D	F	N	3	N	1
870529101	PAIA	B727	JT8D	F	N	3	N	1
870821112	CLGA	B727	JT8D	F	N	3	N	3
870529019	CLGA	B727	JT8D	F	N	3	N	1
880111215	TWAA	DC9	JT8D	F	N	3	N	4
880115111	EALA	B727	JT8D	F	N	3	N	3
880115048	AWXA	B737	JT8D	C	N	2	N	6
870220012	ACLA	B737	JT8D	F	N	3	N	1
870619117	AWXA	B737	JT8D	F	N	3	N	3
871204106	AWXA	B737	JT8D	F	N	3	N	3
870508003	PAIA	B737	JT8D	C	N	3	N	1
871127001	AFLA	B737	JT8D	F	N	3	N	3
870508004	PAIA	B737	JT8D	C	N	2	N	1
870817019	PAIA	B737	JT8D	F	N	3	N	3
871204035	DALA	B737	JT8D	T	N	2	N	3
870130063	UALA	B737	JT8D	F	N	3	N	3
870320030	FDEA	B727	JT8D	C	N	3	N	4
871211017	EALA	DC9	JT8D	F	N	3	N	3
870508028	EALA	DC9	JT8D	F	N	3	N	3
870424084	EALA	DC9	JT8D	F	N	3	N	3
870327014	GATA	B727	JT8D	C	N	3	N	4
870330143	ACLA	B737	JT8D	F	N	3	N	3
870717086	MIDA	DC9	JT8D	F	N	3	N	3
870731171	RJGO	B727	JT8D	T	N	2	N	1
870213001	UALA	B727	JT8D	F	N	3	N	2
870309024	BNFA	B727	JT8D	C	N	2	N	1
871030004	USAA	B727	JT8D	C	N	3	N	4
870619022	DALA	B727	JT8D	F	N	1	N	1
870220023	DALA	B727	JT8D	F	N	1	N	1
870608039	DALA	B727	JT8D	F	N	3	N	4
870406047	PAAA	B727	JT8D	T	N	7	N	5
871106022	PEXA	B727	JT8D	F	N	3	N	3
870928094	DALA	B727	JT8D	F	N	3	N	4
870911006	NWAA	B727	JT8D	F	N	3	N	4
870626021	NWAA	B727	JT8D	C	N	3	N	5
870710080	PAIA	B727	JT8D	F	N	3	N	1
870526065	PAIA	B727	JT8D	F	N	3	N	1
880115032	PAAA	B727	JT8D	T	N	7	N	4
880122032	KTIA	B727	JT8D	C	N	3	N	4
880129099	DALA	B727	JT8D	C	N	1	N	1
870921099	PLAA	NORD 262A	BASTAN	C	B	7	C	5

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870324015	AMWA	SF340A	CT7-5A	T	B	7	C	4
880226007	COMA	SF340A	CT7-5A	T	B	7	C	5
871120024	PLGA	SF340A	CT7-5A	C	N	3	N	3
870724057	AMWA	SF340A	CT7-5A	C	N	7	N	5
870925038	PLGA	SF340A	CT7-5A	T	N	2	N	4
871231083	REXA	SF340A	CT7-5A	T	N	5	N	3
870518122	BHAA	B99	PT6A	T	B	7	C	7
870817052	MAVA	DHC6	PT6A	T	B	7	C	5
870304014	VISA	STCG73	PT6A	T	B	7	C	7
870424010	CHQA	SD330	PT6A	T	B	7	C	10
870223164	CHQA	SD330	PT6A	T	B	7	C	1
870116041	SALA	SD330	PT6A	C	B	7	C	5
870904004	SJSA	DHC7	PT6A	C	B	2	C	5
871023007	AAGA	1400C	PT6A	T	B	1	C	4
870925152	PLGA	SD360	PT6A	T	B	1	C	4
871009184	HNAA	SD330	PT6A	T	B	2	C	3
871120102	CROA	SD330	PT6A	T	B	2	C	2
880111001	SWJA	SD360	PT6A	C	S	7	C	10
880129036	RANA	DHC7	PT6A	T	B	5	C	10
871210030	SW62	AT400	PT6A	C	B	7	C	10
871210026	SW62	UNKNOWN	PT6A	C	B	7	C	1
871210028	SW62	UNKNOWN	PT6A	C	B	7	C	1
871210029	SW62	UNKNOWN	PT6A	C	B	7	C	1
870611155	GLO3	65A90	PT6A	C	N	3	N	5
870304020	CHQA	B99	PT6A	T	N	2	N	1
871030034	CHQA	SD330	PT6A	T	N	7	N	1
871009214	HALA	DHC7	PT6A	T	N	3	N	5
871211024	ASOA	DHC7	PT6A	T	N	7	N	7
871022066	PCAA	1900C	PT6A	C	N	2	N	5
871207034	CLTA	1900C	PT6A	C	N	2	N	4
870116043	SIMA	SD360	PT6A	T	N	2	N	5
870629027	SABA	SD360	PT6A	C	N	3	N	5
870724106	SALA	SD360	PT6A	C	N	2	N	10
870803060	SALA	SD330	PT6A	C	N	3	N	2
880115009	CHQA	SD330	PT6A	T	N	6	N	10
880125011	SWJA	SD360	PT6A	T	N	2	N	1
880122024	SIMA	SD360	PT6A	C	N	2	N	5
871216058	WTAA	EMB110	PT6A	C	N	3	N	7
870403064	PAAA	A310	JT9D	C	B	3	C	5
870713192	FTLA	B747	JT9D	T	B	7	C	4
870612069	FTLA	B747	JT9D	T	B	7	C	3
870918077	PAAA	B747	JT9D	T	B	7	C	3
870612034	PAAA	B747	JT9D	C	B	7	C	3
871211015	PAAA	B747	JT9D	T	B	7	C	3
871204006	TAGA	B747	JT9D/No.4	T	B	7	NC	4
870828001	TWAA	B747	JT9D	C	B	7	C	4
870410019	NWAA	DC10	JT9D	T	B	1	C	3
870731006	TWAA	B747	JT9D	C	B	7	C	4
870508015	TWAA	B747	JT9D	T	B	1	C	4
871211007	TWAA	B747	JT9D	C	B	3	C	4
870817089	NWAA	B747	JT9D	T	B	1	C	4
870731013	NWAA	B747	JT9D	T	B	1	C	4

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870821066	TWAA	B747	JT9D	T	B	7	C	3
870828007	PAAA	B747	JT9D	C	B	7	C	4
870403048	NWAA	B747	JT9D	T	B	2	C	4
870626019	NWAA	B747	JT9D	T	B	2	C	3
870731192	PEXA	B747	JT9D	T	B	7	C	5
870817073	NWAA	B747	JT9D/No.1	T	B	2	NC	4
871026020	NWAA	B747	JT9D	C	B	7	C	6
870410007	TWAA	B747	JT9D	F	B	3	C	3
870724079	TWAA	B747	JT9D	T	B	1	C	3
870524014	TWAA	B747	JT9D	T	B	1	C	4
870306054	NWAA	B747	JT9D	T	B	2	C	4
870817066	TWAA	B747	JT9D/UNK.	F	B	2	NC	10
870731192	PEXA	B747	JT9D	T	B	7	C	5
870821038	TWAA	B747	JT9D	F	B	3	C	1
880111165	PEXA	B747	JT9D	T	B	1	C	3
880129008	NWAA	DC10	JT9D	T	B	7	C	3
880208045	PAAA	B747	JT9D	T	B	7	C	3
870918073	PAAA	B747	JT9D	T	N	7	N	3
870529017	TWAA	B747	JT9D	F	N	3	N	7
870505018	TWAA	B747	JT9D	F	N	2	N	4
871113006	PEXA	B747	JT9D	C	N	7	N	4
870727040	NWAA	B747	JT9D	C	N	7	N	4
871120006	NWAA	B747	JT9D	C	N	3	N	4
871009101	NWAA	B747	JT9D	T	N	5	N	5
870717017	TWAA	B747	JT9D	F	N	2	N	4
871207050	EIAA	B747	JT9D	F	N	3	N	5
870925064	UALA	B767	JT9D	F	N	3	N	4
870828012	TWAA	B767	JT9D	F	N	3	N	4
880115016	FTLA	B747	JT9D	T	N	2	N	4
870706054	NWAA	B757	PW2037	T	B	2	C	4
870710001	DALA	B757	PW2037	C	B	2	C	4
870522008	DALA	B757	PW2037	T	B	2	C	4
871113009	DALA	B757	PW2037	T	B	1	C	4
870807108	SWIA	EHB120	PW118	C	N	3	N	2
870424023	HNAA	DHC8	PW120	T	N	2	N	3
870514031	AMWA	SA226	TPE331	T	B	7	C	4
870902133	AMWA	SA226	TPE331	T	B	7	C	7
871009115	WWMA	SA227	TPE331	T	B	7	C	5
871209041	REXA	JETSTM	TPE331	C	N	3	N	10
870407026	AMWA	SA226	TPE331	C	N	3	N	7
870707100	SWIA	SA226	TPE331	T	N	2	N	1
870115095	WWMA	SA227	TPE331	C	N	3	N	3
871123101	WWMA	SA227	TPE331	T	N	7	N	5
870611215	QXEA	SA227	TPE331	C	N	3	N	7
870902071	MAAA	SA227	TPE331	C	N	3	N	5
870928022	WRNA	CL44	TYNE-515/ No.1	T	B	2	NC	5
870508056	WRNA	CL44	TYNE-515	C	N	3	N	3
870508053	WRNA	CL44	TYNE-515	T	N	2	N	1
870612021	REPA	STCAPJC	501-D13	C	N	3	N	4
870327049	MTRA	STCAPJC	501-D13	C	N	3	N	3
870810139	ASPA	STCAPJC	501-D13	C	N	3	N	5

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870508007	REPA	STCAPJC	501-D13	C	R	7	C	4
870403065	SPAA	STCAPJC	501-D13	T	B	2	C	5
870724259	SRAA	382G	501-D13	C	N	2	N	3
871001015	HHSA	206B3	250C3	C	B	2	C	2
870609198	SW62	206B	250C20	C	B	1	C	1
870601069	SW62	206B	250C20	C	B	7	C	5
870601110	SW62	206B	250C20	C	B	7	C	3
870610024	EA25	206L	250C20	C	B	7	C	5
870714027	EA11	206L	250C20	C	B	1	C	1
870916009	GL61	206B	250C20	C	B	7	C	1
871231067	SW62	206B	250C20	C	B	7	C	10
870702039	GL61	206B	250C20	T	B	2	C	1
870720141	SW62	AS355	250C20	T	B	7	C	7
870408030	SW62	206L	250C28	T	B	7	C	7
871224040	SW62	206L	250C28/UNK.	T	D	7	NC	3
870519055	GL01	UNKNOWN	250C28	C	N	7	N	1
870519056	GL161	UNKNOWN	250C20	C	N	7	N	1
870618120	SW62	206B	250C20	C	N	3	N	1
870512067	WP07	369D	250C20	C	N	7	N	1
870604010	WP07	369D	250C20	C	N	3	N	1
870624062	WP07	369D	250C20	C	N	3	N	5
871203070	WP13	206B	250C20	C	N	2	N	10
871203071	WP13	206B	250C20	C	N	2	N	10
871208068	WP06	206L	250C20	C	N	2	N	10
870902037	GL61	UNKNOWN	250C20	T	N	1	N	1
870902045	GL61	UNKNOWN	250C20	T	N	1	N	1
870902121	GL61	UNKNOWN	250C20	T	N	1	N	1
870908020	GL63	369D	250C20	T	N	7	N	5
871224036	GL61	UNKNOWN	250C20	T	N	1	N	1
871231052	NM67	206B	250C20	T	N	2	N	1
870115027	SW64	AS355	250C20	C	N	3	N	10
871203130	SW64	AS355	250C20	C	N	2	N	1
871027055	SW62	206L	250C20	T	N	1	N	1
871110017	SW62	206L	250C20	T	N	1	N	1
871014011	SW62	206L	250C20	T	N	2	N	1
870803225	NM64	V107-2	CT58	C	B	7	C	5
871202061	NM64	V107-2	CT58	T	N	4	N	1
870610013	S067	500	JT15D/No.1	F	D	7	NC	3
870609136	GL62	550	JT15D	T	B	7	C	10
870930017	GL62	LEAR 35	TFE731	T	B	7	C	1
870908097	GL19	G50	TFE731	T	B	7	C	5
870421035	GL08	LEAR 35	TFE731	T	N	7	N	5
870930016	GL62	LEAR 35	TFE731	T	N	1	N	1
870318043	NM60	250	CJ610	C	N	3	N	4
870428018	CE64	UNKNOWN	CF700	C	N	1	N	1
870814099	DKAA	FALCON	CF700	C	N	3	N	2
880115001	DKAA	FALCON	CF700	C	N	3	N	3
870828019	UALA	DC8	CFM56-2	C	B	1	C	5
870522002	DALA	DC8	CFM56-2	C	B	1	C	4
870403055	UALA	DC8	CFM56-2	T	B	7	C	5
870424053	UALA	DC8	CFM56-2	C	N	3	N	3
871218111	EIAA	DC8	CFM56-2	C	N	3	N	1

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870309006	RAXA	DC8	CFM56-2	F	N	3	N	1
870417062	ACLA	B737	CFM56-3	F	N	3	N	4
870220013	ACLA	B737	CFM56-3	T	N	5	N	7
870828041	USAA	B737	CFM56-3	T	N	2	N	4
871127028	SWAA	B737	CFM56-3	F	N	3	N	3
871002050	SWAA	B737	CFM56-3	F	N	3	N	3
870817027	PAIA	B737	CFM56-3	F	N	3	N	5
871221008	PAIA	B737	CFM56-3	F	N	3	N	3
870821030	PAIA	B737	CFM56-3	T	N	3	N	1
871009092	CKSA	DC8	JT3D	C	B	1	C	5
870424018	ZIAA	DC8	JT3D	C	B	1	C	4
870925057	RAXA	DC8	JT3D	C	B	7	C	3
871009098	RAXA	DC8	JT3D	C	B	7	C	3
870803144	RAXA	DC8	JT3D	T	B	3	C	4
870918016	RAXA	DC8	JT3D	T	B	2	C	3
870831094	RAXA	DC8	JT3D	T	B	1	C	5
870403060	PCTA	B707	JT3D	T	B	7	C	5
870717057	PCTA	B707	JT3D	T	B	7	C	5
870911018	BUFA	B707	JT3D	F	B	7	C	3
871204067	RAXA	DC8	JT3D	T	B	7	C	5
870427013	ZIAA	DC8	JT3D	T	N	7	N	3
870917052	ARWA	DC8	JT3D	C	N	3	N	3
870706039	RAXA	DC8	JT3D	C	N	2	N	3
870306017	RAXA	DC8	JT3D	T	N	7	N	5
870213005	BUFA	B707	JT3D	T	N	7	N	4
870717048	SRAA	B707	JT3D	C	N	2	N	3
870904071	FWTA	B707	JT3D	C	N	3	N	4
870914046	FWTA	B707	JT3D	C	N	3	N	2
870213020	PAIA	F28	SPEY	T	B	7	C	5
870706038	PAIA	F28	SPEY	C	B	7	C	3
870706030	PAIA	F28	SPEY	C	B	1	C	5
870605127	EMPA	F28	SPEY	C	B	7	C	3
870828048	USAA	BAC111-2	SPEY	C	B	2	C	3
871030007	USAA	BAC111-2	SPEY	C	B	3	C	5
871120002	PAIA	F28	SPEY	T	N	7	N	1
870508006	PAIA	F28	SPEY	C	N	2	N	5
870508012	PAIA	F28	SPEY	C	N	2	N	4
870505004	MPCA	F28	SPEY	T	N	7	N	4
880205153	FLEA	BAC111-2	SPEY	C	N	7	N	4
870807049	TWAA	L1011	RB211	C	B	3	C	6
870724135	TWAA	L1011	RB211	C	B	2	C	3
870330102	TAEA	L1011	RB211	T	B	7	C	4
880115148	EALA	L1011	RB211	T	B	7	C	4
870629011	TWAA	L1011	RB211	C	N	7	N	4
870522021	TWAA	L1011	RB211	C	N	3	N	4
870515015	AMTA	L1011	RB211	C	N	7	N	5
870626080	HALA	L1011	RB211	F	N	7	N	5
870821039	TWAA	L1011	RB211	C	N	3	N	3
870925203	DALA	L1011	RB211	T	N	2	N	1
870612086	AMTA	L1011	RB211	T	N	7	N	5
870612018	UALA	L1011	RB211	C	N	2	N	4
870724130	TWAA	L1011	RB211	C	N	2	N	10

SDR NO.	SUBMIT.	AIRCRFT	ENG./LOC.	COMPNT	FRAG. TYPE	CAUSE	CONTN. COND.	FLT. COND.
870824023	TWAA	L1011	RB211	C	N	2	N	4
870717008	ACLA	BAE146-2	ALF502	T	B	2	C	5
870313024	PSAA	BAE146-2	ALF502/No.3	T	D	7	NC	5
870807069	AWAA	BAE146-2	ALF502	T	B	7	C	5
870724002	PSAA	BAE146-2	ALF502	T	B	7	C	5
870918124	ASPA	BAE146-1	ALF502	T	N	1	N	2
870223174	LLLA	BAE146-1	ALF502	T	N	2	N	1
870724222	ACLA	BAE146-2	ALF502	T	N	5	N	5
871204002	MPCA	YS11A	DART/No.1	T	B	7	NC	5
870320029	SALA	F27	DART	T	B	7	C	2
870925069	ANAA	F27	DART	T	B	7	C	8
871023073	AWAA	F27	DART	T	B	7	C	8
870612081	EALA	A300	CF6	T	B	3	C	5
871204031	DALA	DC10	CF6	C	B	2	C	4
871113003	AALA	DC10	CF6	C	B	3	C	6
871023011	UALA	DC10	CF6	C	B	7	C	6
870410001	AALA	DC10	CF6/No.1	T	B	1	NC	5
871113022	UALA	DC10	CF6	T	B	7	C	4
871204087	AALA	DC10	CF6	T	B	7	C	4
871204001	WRLA	DC10	CF6	C	B	3	C	4
880122067	UALA	DC10	CF6	C	B	2	C	10
871211158	EALA	A300	CF6	T	N	1	N	1
871019026	EALA	A300	CF6	T	N	2	N	10

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